EVALUATION OF THE OUTCOME OF ALVEOLAR SOCKET PRESERVATION BY PLACING EITHER BIO-OSS; OR BIO-OSS WITH PRF, FOLLOWED BY DELAYED IMPLANT PLACEMENT – A PROSPECTIVE CLINICAL STUDY

Dissertation submitted to

THE TAMILNADU Dr. MGR MEDICAL UNIVERSITY

In partial fulfillment for the Degree of

MASTER OF DENTAL SURGERY

BRANCH III

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CHENNAI

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled **"EVALUATION OF THE OUTCOME OF ALVEOLAR SOCKET PRESERVATION BY PLACING EITHER BIO-OSS; OR BIO-OSS WITH PRF, FOLLOWED BY DELAYED IMPLANT PLACEMENT – A PROSPECTIVE CLINICAL STUDY"** is a bonafide record and genuine research work done by me under the guidance of **Dr. J. A. NATHAN, M.D.S.** Professor, Department of Oral & Maxillofacial Surgery, Ragas Dental College and Hospital, Chennai.

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This Dissertation is submitted to **THE TAMILNADU Dr. MGR MEDICAL UNIVERSITY,** in partial fulfillment for the award of the Degree of **MASTER OF DENTAL SURGERY – ORAL AND MAXILLOFACIAL SURGERY, BRANCH III.** It has not been submitted (partial or full) for the award of any other degree or diploma.

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On verification with the unkund.com website for the purpose of plagiarism check, the uploaded thesis file from Introduction to Conclusion contains 4% of plagiarism, as per the report generated and it is enclosed in Annexure – II.

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ABSTRACT

PURPOSE: The aim of the study is to assess and evaluate the outcome of Alveolar sockets by placing either Bio-Oss or Bio-Oss with Platelet rich fibrin immediately following extraction; followed by Endossous Dental Implant placement as a delayed procedure.

MATERIALS AND METHOD: This is a prospective study including 16 preservation sites in 14 patients undergoing extraction immediately followed by placement of Bio-Oss alone in 8 sites & Bio-Oss mixed with PRF in 8 sites and the patients were between the age group of 18-50 years (adults). The first group of patients (Group A) received Bio-Oss which is a bone graft and the second group (Group B) received Bio-Oss mixed with Platelet Rich Fibrin (5ml patients own blood, centrifuged at 3000 rpm for 10 min) as the bone preservation agent. The buccolingual width, the clinical height, the radiological vertical height (long cone paralleling angle technique which is a measurement from the adjacent tooth's root tip/CEJ to the visible outer cortical lining) and soft tissue status were assessed immediately following extraction (Stage 1), 10 days after during suture removal & prior to implant placement after approx. 3 months (Stage 2). The implants were placed between 3-10 months and the stability and survival rate of the implants were measured. Finally, after evidence of successful integration, the Implants were loaded (Stage 3).

RESULTS: Both the groups A & B were evenly distributed with respect to age, gender, site, periodontal status. An overall reduction of the clinical bucco-palatal width, clinical height and radiographic height were found in all 3 stages of evaluation but was not significant with respect to both the groups. Both Group A and Group B show similar socket dimensional changes.

CONCLUSION:

Within the limitations of the study, it can be inferred that the use of PRF along with bone grafts for socket preservation improves handling properties & soft tissue healing but with respect to maintaining the socket dimensions there is no clear statistical evidence to justify its use along with bone grafts.

Key words: **Bio-Oss, Platelet-Rich fibrin, Socket preservation, Bucco-lingual width, Radiographic height.**

CONTENTS

LIST OF TABLES

LIST OF GRAPHS

Introduction

INTRODUCTION

Since time immortal there has been events recorded in history of lost tooth being replaced by artificial means. This led to the field of dentistry and further advancements followed [1][2]. The thought of having an artificial tooth fixed in the alveolus performing the normal function has eluded the minds of people for some time but not for long. The field of Oral Implantology has grown in leaps and bounds and is currently the go to option when it comes to fixed replacement and prosthesis [3].

As a good foundation is for a successful structure to be in place, so is a good alveolar ridge a prerequisite for successful dental implant placement. The major issue with it is that, there is definite loss of alveolar structure when a tooth is lost, in all three dimensions. The actual bone that is present before the tooth was lost is the same amount required for similar and strong implant placement. Socket preservation technique is as old as the field of Implantology and is by far the most reliable technique when it comes to maintaining the residual alveolar bone and maintaining the width and height [4][5].

The resorption pattern seen after tooth extraction is characterized by rapid reduction in the first 3–6 months, followed by gradual reduction

thereafter [6]. Horizontal buccal bone resorption is as much as 56%, while lingual bone resorption has been reported to be upto 30% [7]. Major bone resorption of the vestibular wall of the extraction socket can be attributed to the higher proportion of bundle bone, a tooth-dependent tissue through which the periodontal ligament fibers are anchored to the jaws, which undergoes resorption due to the loss of its function.

The volume reduction of the alveolar process may prevent or render difficult implant installation in a prosthetically driven position, simultaneously jeopardizing the functional and aesthetic outcomes. Thus, ridge preservation treatment protocols have been developed in order to maintain the alveolar bone volume existing at the time of tooth extraction, and to ensure the support of an adequate ridge profile

Alveolar socket preservation (ASP) is a procedure in which a graft material is placed in the socket of the extracted tooth at the time of extraction, with or without the application of barrier membranes or soft tissue coverage, to preserve or improve the original ridge dimensions and to allow an ideal implant location [8].

A successful esthetic and functional restoration of the implant depends on its optimal placement, which is influenced by its height and buccolingual position as well as by the alveolar ridge dimensions [9]. Prerequisites for successful implant therapy are integration of the implant, ideal implant position and appropriate hard and soft tissue contours. These

require sufficient alveolar bone volume and favorable ridge architecture coupled with an appropriate surgical technique [10]. Socket preservation most of the time eliminates or often at least minimizes the necessity for future augmentation procedure. Success of dental implants are not only weighed by osseointegration but also the long-term stability of the prosthesis including form, function and aesthetics [11].

Healing of extraction socket involves retention of clot followed by a sequence of events that lead to changes in the alveolar process in all three dimensions. The key element is to act at the time of tooth extraction and to prevent the collapse of the ridge [12]. Since the surgical placement of implants have become a routine part of treatment planning, clinicians need to consider socket preservation at the time of extraction, as an increasingly predictable method of ridge preservation [13]. Several techniques have been employed as ridge preservation procedures involving the use of bone grafts, barrier membranes, and biologics to provide a better restorative outcome [14].

Site preservation through socket grafting will help optimize bony fill within the extraction socket, thereby maintaining vertical bone height and helping to stabilize the marginal soft tissue at the site [15]. Maintenance of the hard and soft tissue envelope and stable ridge volume are important aims to allow simplifying subsequent treatments and optimizing their outcomes, when implants are planned to be placed [16].

It is well documented and researched in the literature that Bio-Oss (Geistlich Pharma AG, Wolhusen, Switzerland) has various beneficial properties when used as a bone preserving agent. Bio-Oss is a Deproteinized Bovine Bone Mineral (DBBM) and is a defatted and deproteinized xenograft reduced to porous grains of different dimensions (0.25–2 mm) and deprived of all its organic components through high-temperature processes in order to minimize the immune response.

The particles in the Bio-Oss graft have properties to encourage bone fill and act as a stable grafting substance. It is noted that socket dimensions are reduced by 21-43% by spontaneous healing after tooth extraction without the use of bone grafts but the use of the Bio-Oss bone graft substance has significantly held the socket in place and the socket dimensions reduce only by 8-17%. The use of Bio-Oss bone graft is considered here [17].

Recently the use of platelet concentrates has been proposed as an aid for enhancing regeneration of osseous and epithelial tissue in oral surgery [18]. Platelets play a significant role in wound healing as they have the various growth factors necessary for the sequel of wound healing.

Platelet rich plasma (PRP), an autologous concentrate of human platelets in a small volume of plasma have demonstrated to induce healing. The use of it in oral surgical procedures have been increasingly popular

since its introduction but the use of it, has declined ever since. PRF has taken over because of the ease of preparation with better results [19].

Platelet Rich Fibrin (PRF) is a 2nd generation platelet concentrate with reduced preparation time and better handling properties developed by Choukroun et al 2001. Unlike PRP, it is derived by natural and progressive polymerization occurring during centrifugation without addition of any anticoagulant [20]. PRF has also been studied about its bone preservation properties in the past [21].

Therefore, in this study either Bio-Oss separately or Bio-Oss mixed with PRF was used as a socket preservation agent followed by delayed implant placement and loading protocol.

Aims & Objectives

AIMS AND OBJECTIVES

This prospective clinical study is designed to evaluate the outcome of either Bio-Oss separately or Bio-Oss mixed with PRF as socket preservation agent

1. Evaluate and tabulate the socket preservation site's dimensional changes followed by delayed Endossous Dental Implant placement and delayed loading protocol
2. Evaluate the overall stability and survival rate of the Implants placed in these sockets.

Review of Literature

REVIEW OF LITERATURE

Pietrokovski, Jaime et al (1967) [22] studied about the alveolar ridge resorption in 149 plaster casts with single teeth missing through extraction and concluded that

1. The buccal plate in the both maxilla and mandible was resorbed to a greater extent than the palatal plate. The centre of the edentulous ridge therefore, shifts to a position closer to the palatal plate of bone.
2. The amount of tissue resorption was significantly greater in the edentulous molar region than in the incisor and premolar regions of both jaws.

Bragger, U., Pasquali, L., & Kornman, K. S. (1988) [23]**.** This was one of the early articles where the term 'Alveolar Socket Preservation' was used, where the author analysed the socket dimensions along with Interdental bone changes after various flap procedures. The study was assessed by computer-assisted densitometric image analysis (CADIA). Standardized radiographs were digitized and quantitative information regarding density changes was obtained. The study showed a path towards socket preservation which can be an effective procedure in maintaining the dimensions and prevent the socket from collapsing.

Mecall & Rosenfeld (1992) [24] discussed the influence of residual ridge resorption patterns on Implant placement and tooth position. The incorporation of prosthetic information into a presurgical implant treatment plan is essential to provide accurate guidelines for fixture placement by the surgeon. The first part of the article gives a modified surgical technique to construct a prosthesis compatible with the final tooth position. The second part describes a technique in which a computer profile image is used to identify the determinants of the optimal final tooth position and discusses the impact of these determinants on the prosthetic design.

Smukler et al, (1999) [25] determined the fate of demineralized freeze-dried bone allograft (DFDBA) used in conjunction with a barrier membrane in the management of 5 extraction sockets and compared it with the amount of bone formed in 5 untreated sites. After an adequate healing time (8-23 months) just prior to implant placement, bone biopsy was taken and Histomorphometric analysis done. They concluded that treatment with DFDBA in conjunction with cell occlusive membranes will result in new bone formation, predominantly by the process of conduction, which appears to be similar in amount and nature to that found in cores harvested from healed non-functional edentulous areas.

Berglundh & lindhe (1997) [26] did an animal study to check the Healing around implants placed in bone defects treated with Bio-Oss and found out that, Bio-Oss becomes integrated and subsequently replaced by

newly formed bone. 5 beagle dogs, about 1-year-old, were used. Bio-Oss was seen to fulfil the criteria of an osteoconductive material. It was also observed that 4 months after implant installation, the titanium/hard tissue interface at test and control sites exhibited, from both a quantitative and qualitative aspect, a similar degree of "osseointegration".

Artzi et al (2000)[27] histomorphologically analysed the healing of porous bovine bone graft (PBBM) in 15 human extraction sockets and concluded that newly formed bone was characterized by abundance of cellular woven-type bone in the coronal area, while lamellar arrangements could be identified only in the more apical region. New osseous tissue adhered to the PBBM. Therefore, it is seen that PBBM particles are an appropriate biocompatible bone derivative in fresh extraction sockets for ridge preservation. The resorbability of this xenograft could not be recognized in a 9-month period as all the samples had residual bone graft materials.

Tassos Irinakis (2006) [28] concluded in his study that post-extraction maintenance of the alveolar ridge minimizes residual ridge resorption and thus, allows placement of an implant that satisfies aesthetic and functional criteria. Recent advances in bone grafting materials and techniques allow the dentist to place implants in sites that were considered compromised in the past.

I Darby, S Chen, R De Poi, (2008) [29] Implant treatment can be facilitated at the time of extraction by considering ridge preservation and

maintaining sufficient bone for optimal implant placement and consequently the appearance. Consideration has been given to healing of extraction sockets and previously published studies that have attempted to preserve the alveolar ridge. The majority of teeth are extracted by general dental practitioners and it is hoped that this article will stimulate some thought on the topic of ridge preservation. Not all extraction sockets need to be preserved, but the authors feel that ridge preservation ought to be considered at the time of tooth removal.

Michael Danesh-Meyer (2008) [15] Site preservation through socket grafting will help to optimize bony fill within the extraction socket, thereby maintaining vertical bone height and helping to stabilize the marginal soft tissues at the site which plays an integral part in surgical placement of dental implants. Guided bone regeneration with the use of particulate bone graft and resorbable membranes remains the most widely used technique at present.

Fickl S, Zuhr O, Wachtel H, Stappert CFJ, Stein JM, Hu¨rzeler MB (2008) [30] concluded that Socket preservation techniques, used in the present experiment, were not able to entirely compensate for the alterations after tooth extraction. Yet, incorporation of Bio-Oss Collagen seems to have the potential to limit but not avoid the postoperative contour shrinkage. The study clearly stated that complete ridge preservation is not possible with the socket preservation techniques evaluated in the study.

Fickl S, Zuhr O, Wachtel H, Bolz W, Huerzeler MB (2008) [31] concluded that the findings from the present study disclose that incorporation of Bio-Oss Collagens into the extraction socket has only limited impact on the subsequent biologic process with particular respect to the buccal bone plate. The horizontal measurement of the alveolar ridge depicted that the loss of the buccal bone plate was replaced to a certain amount by newly generated bone guided by the Bio-Oss collagens scaffold. It seems that the mechanical stability provided by Bio-Oss collagens and furthermore by a free gingival graft could act as a placeholder preventing the soft tissue from collapsing.

Fickl S, Schneider D, Zuhr O, Hinze M, Ender A, Jung RE, Hurzeler MB (2009) [32] Did an animal study and studied the dimensional changes of the ridge contour after socket preservation and buccal overbuilding. It was concluded and statistically proved from their study that overbuilding the buccal aspect in combination with socket preservation is not a suitable technique to compensate for the alterations after tooth extraction.

Ivan Darby, Stephen T. Chen, Daniel Buser (2009) [10] Authors did a review of literature of the articles relating to ridge preservation and concluded that Ridge preservation procedures are effective in limiting horizontal and vertical ridge alterations in post-extraction sites. The authors stressed the importance of knowing the internal and external changes that happen in the sequence of events that follow in the extraction of a tooth. There is no evidence to support the superiority of one technique over another. There is

also no conclusive evidence that ridge preservation procedures improve the ability to place implants.

Mardas N, Chadha V, Donos N (2010) [33] compared the potential of a synthetic bone substitute, Straumann Bone Ceramics (SBC) or a bovine-derived xenograft, Bio-Oss deproteinized bovine bone mineral (DBBM) combined with a collagen membrane to preserve the alveolar ridge dimensions following tooth extraction in 26 patients. It was seen that both biomaterials partially preserved the width and the interproximal bone. The histologic analysis showed new bone formation in the apical part of the biopsies, which was in direct contact with the bone grafting particles. The coronal part of the biopsies were filled with dense fibrous connective tissue surrounding the bone grafting particles.

Luis André Mezzomo, Rosemary Sadami Shinkai et al (2010) [9] Several techniques and materials have been suggested for alveolar ridge preservation (ARP) after dental extraction and before implant placement. Ridge preservation procedures are efficient in limiting the post-extraction dimensional loss of the ridge and are accompanied by a different degree of bone regeneration, with varied amounts of residual graft material particles.

Fawad Javed a, George E. Romanos (2010) [34] reviewed and stated that, it is evident that the core issue to observe during immediate loading is the establishment of a good implant primary stability. There is sufficient evidence to suggest that the degree of achieved primary stability during IL protocols is

dependent on several factors including bone density and quality, implant shape, design and surface characteristics and surgical technique including implants placed in a preserved site. But if the stability of the implant cannot be achieved then site preservation protocols could be followed for a delayed implant placement.

Gholami GA, Najafi B, Mashhadiabbas F, Goetz W, Najafi S (2011) [35] compared a nanocrystalline hydroxyapatite (NCHA), NanoBone and a deproteinized bovine bone mineral (DBBM), Bio-Oss with a collagen membrane on the horizontal ridge width. Alterations following tooth extraction in 28 symmetrical, non-molar extraction sockets using a split-mouth design in the adult population, was found and socket preservation with both the materials resulted in similar and limited horizontal ridge width alterations following tooth extraction. In the DBBM group, the width decreased from 7.75 +/- 1.55 to 6.68 +/- 1.85 mm whereas the width of the NCHA group decreased from 7.36 +/- 1.94 to 6.43 +/- 2.08 mm. In both the groups the readings were not statistically significant.

CHF Hammerle, Arau´ jo MG, Simion M (2011) [16] demonstrated that the alveolar ridge undergoes a mean horizontal reduction in width of 3.8 mm and a mean vertical reduction in height of 1.24 mm within 6 months after tooth extraction. The techniques aimed at ridge preservation encompassed two different approaches: i) maintaining the ridge profile, ii) enlarging the ridge profile. Regarding timing of implant placement, the literature showed that

immediate implant placement leads to high implant survival rates. This procedure is primarily recommended in premolar sites with low aesthetic importance and favourable anatomy. In the aesthetic zone, however, a high risk for mucosal recession was reported. Hence, it should only be used in stringently selected situations with lower risks and only by experienced clinicians. In molar sites a high need for soft and hard tissue augmentation was identified.

Hassan, Marei, and Alagl et al (2011) [36] studied the osseous defects after surgical removal of impacted 3rd molars and covered the extracted site with combined autogenous graft with Bio-Oss bone graft materials. From their study they concluded that grafting of osseous defects and extraction site with autogenous bone graft combined with Bio-Oss materials will predictably result in a decreased risk of developing a periodontal defect.

K. Patel, N. Mardas, N. Donos (2012) **[37]** stated that there was no significant difference in radiographic bone levels and success and survival of implants placed in sites previously preserved with SBC (Straumann bone ceramic) or DBBM (Bio-Oss) at 1-year follow-up (post-loading). The study was done in 27 patients who were randomly assigned into the groups. SBC could therefore be a suitable alternative to DBBM for ridge preservation prior to implant placement. In literature, DBBM forms a standard upon which other bone grafting materials are compared.

Ahmad Kutkut, Sebastiano Andreana, Hyeong-ll Kim, and Edward Monaco Jr (2012) [38] stated that major changes in an extraction site happened during the 1st year after tooth extraction, with two thirds of the bone loss occurring within the first 3 months. The study was done on 16 patients assigned into two groups. Medical-grade calcium sulfate hemihydrate (MGCSH) mixed with platelet-rich plasma (PRP**)** showed greater vital bone volume at 3 months with rapid enhancement of bone healing compared to PRP-free collagen resorbable graft based on Histomorphometric analysis. There was no clear statistically significant difference clinically in both vertical and horizontal bone resorption between the groups.

XU lixin, Ding yun, Lei chaofeng, Jiang weipeng (2012) [39] showed the use of Advance Platelet-rich fibrin (platelet-rich fibrin PRF) in 6 patients with immediate implants in the aesthetic zone. It was seen that even in the presence of chronic periapical lesions which were debrided, the implant sites healed well and the pink esthetic score reached 10 or more. The various growth factors in the PRF synergies and promote tissue regeneration/repair. The earlier clinical success rate of bone graft & anti-infective ability were the substantial benefits.

Robert Horowitz, Danny Holtzclaw, Paul S. Rosen (2012) [5] There appears to be consensus from the reviewed literature supporting ridge preservation techniques as a whole. Multiple studies demonstrated less ridge resorption occurring when alveolar ridge preservation procedures were used

versus the placement of no graft material in fresh alveolar sockets. The analysis did not show any grafting materials demonstrating a clear benefit over any others or that a barrier membrane is necessary. The evidence is also too premature about whether socket preservation efforts require primary closure. In the emerging area of growth factors, there is no high-quality evidence to either support or refute the use of socket grafting measures.

Marco Tatullo, Massimo Marrelli, et al (2012) [40] The present study is to investigated, clinically and histologically, the potential use of PRF, associated with deproteinized bovine bone (Bio-Oss), as grafting materials in pre-implantology sinus grafting of severe maxillary atrophy, in comparison with a control group, in which only deproteinized bovine bone (Bio-Oss) was used as reconstructive material. With the adding of PRF the lamellar bone tissue with an interposed stroma appeared relaxed and richly vascularized. The author concludes that the use of PRF and piezo-surgery reduced the healing time, compared to the 150 days described in literature, favouring optimal bone regeneration. At 106 days, it is already possible to achieve good primary stability of endosseous implants, though lacking functional loading.

Giorgio Pagni, Gaia Pellegrini, William V. Giannobile and Giulio Rasperini (2012) [41] reviewed the literature and stated that Socket grafting is a commonly adopted therapy for the preservation of alveolar bone structures in combination or not with immediate implant placement**.** Molar sockets present higher degree of resorption than the premolars do. The authors

recommend that a less invasive grafting technique to be adopted when indicated especially in the esthetic zones. Invasive procedures like guided bone regeneration and sinus lift are less frequently needed if a proper socket preservation is adopted.

Jung RE, Philipp A, Annen BM, Signorelli L, Thoma DS, Ha¨mmerle CHF, Attin T, Schmidlin P (2013)[17] evaluated the radiographic changes of the alveolar ridge following application of different ridge preservation techniques 6 months after tooth extraction. Four treatment modalities were randomly assigned in 40 patients: b-tricalcium-phosphate-particles with polylactid coating (b-TCP), demineralized bovine bone mineral with 10% collagen covered with a collagen matrix (DBBM-C/CM), DBBM-C covered with an autogenous soft-tissue graft (DBBM-C/PG) and spontaneous healing (control). Cone-beam computed tomography scans were performed after treatment and 6 months later. Application of DBBM-C, covered with CM or PG, resulted in less vertical and horizontal changes of the alveolar ridge as compared with controls 6 months after extraction.

Qi Li, Shuang Pan, Smit J. Dangaria, Gokul Gopinathan, Antonia Kolokythas, Shunli Chu, Yajun Geng (2013) [42] study suggest that PRF enhances osteogenic lineage differentiation of alveolar bone progenitors more than of periodontal progenitors by augmenting osteoblast differentiation, RUNX2 expression, and mineralized nodule formation via its principal component fibrin. They also document that PRF functions as a complex

regenerative scaffold promoting both tissue-specific alveolar bone augmentation and surrounding periodontal soft tissue regeneration via progenitor-specific mechanisms.

B Kassim, S Ivanovski, N Mattheos (2014) [43] Ridge preservation techniques are effective in minimizing post-extraction alveolar ridge contraction. However, there is insufficient evidence to suggest that the use of these techniques in conjunction with dental implant treatment improves implant treatment outcomes. Furthermore, ridge preservation does not necessarily eliminate the need for further simultaneous augmentation at the time of implant placement. The delayed healing associated with ridge preservation using socket grafting necessitates a commitment to a delayed placement protocol. The extended treatment time, compromised healing and expense related to ridge preservation suggests a more cautious approach with regards to the indication of such techniques.

Elizabeth M. Tomlin, Shelby J. Nelson and Jeffrey A. Rossmann (2014)[12] Healing of the extraction socket after tooth removal involves retention of the blood clot followed by a sequence of events that lead to changes in the alveolar process in a three-dimensional fashion. This normal healing event results in a minimal loss of vertical height (around 1 mm), but a substantial loss of width in the buccal-lingual plane (4-6 mm). During the first three months following extraction that loss has been shown to be significant and may result in both a hard tissue and soft tissue deformity affecting the

ability to restore the site with acceptable aesthetics. Procedures that reduce the resorptive process have been shown to be predictable and potentially capable of eliminating secondary surgery for site preparation when implant therapy is planned. The key element is prior planning by the dental therapist to act at the time of extraction to prevent the collapse of the ridge due to the loss of the alveolus.

Several techniques have been employed as ridge preservation procedures involving the use of bone grafts, barrier membranes and biologics to provide a better restorative outcome. This review explored the evidence behind each technique and their efficacy in accomplishing site preparation. The literature does not identify a single technique as superior to others; however, all accepted therapeutic procedures for ridge preservation have been shown to be more effective than blood clot alone in randomized controlled studies.

Dhurat R, Sukesh MS (2014) [44] The utility of platelet-rich plasma (PRP) has spanned various fields of dermatology from chronic ulcer management to trichology and aesthetics, due to its role in wound healing. There is also a wide variation in the reported protocols for standardization and preparation of PRP, in addition to lack of accurate characterization of the tested products in most articles on the topic. Additionally, the high cost of commercially available PRP kits, precludes its use over a larger population.

Jie Liu and David G. Kerns (2014)[45] Guided Bone Regeneration (GBR) is a surgical procedure that uses barrier membranes with or without particulate bone grafts or/and bone substitutes. Angiogenesis and ample blood supply play a critical role in promoting bone regeneration. Guided bone regeneration can be achieved with using particulate autogenous bone grafts, allografts, xenografts, or alloplastic grafting materials and resorbable or non-resorbable barrier membranes techniques.

Dias DR, Leles CR, Lindh C, Ribeiro-Rotta RF (2014) [46] Evaluated the changes in marginal bone level (MBL) around implants, in sites with different bone types, affecting the over-time implant stability measured by resonance frequency analysis (RFA). Implant bone sites were grouped according to the Lekholm and Zarb bone classification. The implant stability quotient (ISQ) was measured by RFA at four time points: implant placement, uncovering, rehabilitation, and at 1-year follow-up after loading. Percent change in bone level was calculated based on the difference between the implant length and height from the crestal bone level to the implant apex. It was concluded that there was increased implant stability after implant placement, but it was not affected by changes in marginal bone level during the first year of loading.

Markus Glocker, Thomas Attin and Patrick R. Schmidlin (2014) [47] It has also been suggested that resorption of the buccal bundle bone can be avoided by leaving a buccal root segment (socket shield technique) in place,

because the biological integrity of the buccal periodontium (bundle bone) remains untouched.

Eduardo Borie, Daniel García Oliví, Iara Augusta Orsi, Katia Garlet, Benjamín Weber, Víctor Beltrán, Ramón Fuentes (2015) [18] in their article meticulously jotted the various applications and the versatility of the use of PRF in dentistry. Platelet rich fibrin (PRF) appears as a natural and satisfactory alternative with respect to bioactive surgical additives to regulate inflammation to increase the speed of healing process, with favourable results and low risks. PRF alone or in combination with other biomaterials seems to have several advantages and indications both for medicine and dentistry, as it is a minimally invasive technique with low risks and satisfactory clinical results. It is said to increase the healing rate of the grafted bone when used in combination with the same.

Chihiro Masaki, Tetsuji Nakamoto, Taro Mukaibo (2015) [11] The anterior maxilla is in the esthetic zone, and the thickness of the bone on the labial side around the natural tooth is less than 1 mm in many cases. Therefore, it is impossible to prevent bone resorption completely, even if ridge preservation and immediate or early implant placement are performed after tooth extraction. It is necessary to obtain stable and long-term esthetics by combining connective tissue and free gingival grafts, in addition to hard tissue augmentation.

Zeeshan Sheikh, Nader Hamdan, Yuichi Ikeda, Marc Grynpas, Bernhard Ganss and Michael Glogauer (2017) [48] in their article reviewed the importance on the placement of a barrier membrane to limit the epithelial down growth. In an attempt to overcome complications related to the epithelial down-growth and/or collapse of the non-rigid barrier membrane and to maintain space, clinicians are recommended to commonly use a combination of membranes with hard tissue grafts.

Pâmela Letícia Santos, Edilson José Ferreira, Marcos M. Kuabara et al (2017) [14] Two and a half months after the dental extraction and the filling with Bio-Oss, it was possible to observe through tomograpic image that the alveoli of the teeth 11 and 21 were completely filled with mineralized tissue. Authors concluded that the biomaterial Bio-Oss is efficient for the preservation of the alveolar bone after dental extraction, acting as a framework for the bone neoformation for a later installation of osseo-integrated implants.

Carlo Maiorana, Pier Paolo Poli *et al* (2017) [8] Noted a trend towards reduction of horizontal and vertical socket dimensions from baseline to the final examination. The mean width and height of resorption were 1.21 mm (P=0.005) and 0.46 mm (P=0.004), respectively. Socket preservation using demineralised bovine bone mineral (Bio-Oss) provided stable dimensional changes of the alveolar ridge associated with good re-epithelialisation of the soft tissues during a 6-month healing period.

Madhan G, Singh M (2017) [21] The 22 patients in the study received either PRF or Collaplug (Zimmer) as the preservation agent. Both the groups were analysed for vertical buccal crestal. Bone heights were measured immediately after extraction; at 4 months and implants were placed. It was concluded that both the two materials tested seem to be effective in the treatment of extraction sockets. The study lacked a negative control and could not completely attribute the extent of the clinical improvement of PRF *per se*, but it was stated that preparation of PRF is not very cumbersome and inexpensive, which makes it a better socket preservation material.

Tomasi C, Donati M, Cecchinato D (2018) [64] analysed in their study the characteristics of fresh extraction sockets subsequent dimensional changes. Three dimensional virtual models were analysed using Geomagic software and the dimensional changes were calculated. It was concluded that the width of the marginal portion (2mm-4mm apically of the crest) of the ridge shrunk by 20%-30%. Eventually, about 6mm of the horizontal dimension was lost at the extracted site. It was also seen that the ridge reduction was twice as large at the buccal/facial when compared to the lingual/palatal aspect thus after first 3 months, the horizontal dimension was reduced by 30% and at 12 months, it was from 30-40%. It was stated that the hard tissue change following tooth extraction may not parallel soft tissue change.

Materials and Methods

MATERIALS AND METHODS

For this prospective study, the study subjects were the patients who had tooth/teeth that are indicated for extraction and consented for a socket preservation procedure with a future implant placement in mind. These were patients who reported to the Department of Oral and Maxillofacial Surgery, Ragas Dental College and Hospital, Chennai. For the study the patients were randomly assigned into two groups. The first group received only Bio-Oss bone grafting material as the bone preservation agent whereas the second group received Bio-Oss mixed with PRF (5ml patients own blood, centrifuged at 3000 rpm for 10 min) as the bone preserving agent. In both the groups a standard resorbable Guided Tissue Regeneration membrane was used to cover and hold the bone graft in place.

There was a total of 8 socket preservation sites in which implants were placed in each group, accounting for a total of 16 sites in 14 patients. All patients had a single tooth to be replaced except 2 patients who had two sites (one in each group). The implant placement was planned approx. 4-6 months after the socket preservation procedure.

Before the commencement of the study an Ethical committee approval was obtained from the Institutional Review Board in Ragas Dental College and Hospital, Chennai. All the patients were clearly explained about the

procedure and they agreed to be a part of the study protocol by submitting a written Informed consent (Annexure II). All patients were recalled and reviewed postoperatively at definite time intervals.

INCLUSION CRITERIA: -

1. Tooth indicated for extraction (caries, endodontic complications, crown fractures)
2. All patients who give a written consent
3. Age group between 16-50 years.
4. Both sexes were included
5. Desire for Implant placement following extraction of non - restorable tooth and socket preservation.
6. Good general health
7. Be available for follow-up examinations
8. Patients with fair periodontal status

EXCLUSION CRITERIA:

1. History of systemic diseases that would contraindicate surgical treatment.
2. Compromised health conditions, which would affect wound healing

3. Patients who do not accept the use of xenograft (religious reason)
4. Acute infection in the surgical site
5. Periodontal disease with bone loss
6. Known allergy to any of the materials used in the study
7. Failure to sign a informed consent
8. Ankylosed tooth.
9. Pre-existing bone loss >50%

ARMAMENTARIUM USED: -

1. 2% Lignocaine with 1:80,000 Epinephrine
2. Extraction forceps & Periotomes
3. Bio Oss
4. (Universal Centrifuge) Platelet rich fibrin
5. Ethilon sutures
6. Caliper/marked probe.
7. Implants (Adin universal system)
8. Physiodispensor

Pre-operative a-silicon impressions were taken and diagnostic casts poured, the Intra Oral Periapical Radiographs were taken (long cone paralleling angle technique for reproducibility) clinically the site to be preserved was measured with a caliper/probe with markings. No pre-op medications were prescribed for both groups. The study precedes with a formal written consent from the patient.

SURGICAL TECHNIQUE for socket preservation: -

Patient was draped and asked to wash with 0.2% betadine solution. Extraction of the concerned non-restorable tooth was performed with great care to preserve the buccal bone plate and the surrounding soft and hard tissues. After administration of local anaesthetic with adrenaline (2% Lignox 1:80,000), crevicular incisions were made around the tooth structure with a scalpel, no 15. Minimal flap elevation was done just to visualize the surrounding bone level. Initially the tooth was gently luxated with the use of a sharp Luxator (GDC Luxatip set) at the junction between the tooth-bone interface. No attempt was made to elevate but just to make the tooth structure inside the socket mobile, any inadvertent expansion of the socket during luxation was beneficial for the socket dimensions as long as the damage to the socket walls was minimal. The mobile tooth was grasped by root forceps and rotated & extracted along the axis of the tooth without any buccal traction.

After tooth extraction, careful removal of the granulation tissue (if present) was done with hand instruments and rinsed with sterile saline, the

width of the socket was measured mesio-distally and bucco-lingually to the base of the crestal bone, the height of the buccal and lingual bone plate was clinically measured to the nearest 0.5 mm at the mid-buccal and mid-lingual aspect using a periodontal probe. The extracted tooth's dimensions were also measured

Group A:

Extraction was followed by gently packing of the alveolar sockets with Bio-Oss bone graft alone, which is wetted with saline in a sterile Dappen dish. Excessive pressure was avoided as the spaces in between the bone graft particles were allowed to be filled by blood. The socket is completely packed till the crestal bone level anticipating a slight crestal bone resorption. Any bone particles which overflowed were carefully removed with a sharp instrument. A resorbable GTR membrane (Healiguide, APT Pharma), with dimensions relating to the socket was adapted over the bone cover and tucked into the flaps. No sutures were placed over the resorbable membrane, but flaps were approximated by either 3-0 or 4-0 silk sutures to get maximum cover. A slight expose of the membrane to the oral environment was inevitable in most situations.

Group B:

Just before the extraction procedure, 10ml of patient's own blood is drawn by a scalp-vein set into two 5ml plastic test tubes without the

anticoagulant. The blood containing test tubes were immediately transferred to a centrifuge approx. 400g (Remi R&C Lab centifuge) for 3000 rpm for 10 mins and allowed to rest for a further 15 mins for the clot formed to mature and form the actual PRF, this method is slightly different to original protocol formulated by Dolan & Choukroun, 2006[49,50,51]. It was observed that the resting of the test tubes for 15 mins allowed for a stable and consolidated formation of the PRF jelly. The PRF was taken from the test tube by a sharp tweezer, and the PRF- residual RBC junction visualized. The separation of the PRF was done more towards the residual RBC side as it is seen that the many vital growth factors reside here; care was taken not to eliminate the vital growth factors. The PRF jelly was mixed with Bio-Oss bone graft particles and gently packed into the socket, similar to Group A. A part of the PRF jelly was flattened and kept over the admixture. A resorbable membrane was placed over the socket and sutured with either 3-0 or 4-0 silk sutures to get maximum cover.

Post-op instructions:

Strict oral hygiene instructions were given.

Patients were instructed to rinse twice a day with 0.2% Chlorhexidine and avoid any alcohol containing mouthwashes.

Patients were also instructed to avoid chewing at the treated sites, manipulation of the site with tongue or probing the site with objects.

Patients received pain killer medication (Imol plus) and antibiotics (Amoxicillin) (Metronidazole) for 5 days.

Postoperative follow-up:

All patients were recalled at 7–14 days for check-up and suture removal. They were also inspected for any swelling or release of graft material. The condition of the membrane was documented.

Interim prosthesis was fabricated either as Maryland winged Bridge which is resin bonded on the lingual aspect or as Partial denture with adequate relief over the preserved site in the anterior esthetic zone.

Patients were advised not to inadvertently give any pressure or trauma over the site which is preserved.

The preserved site is allowed to heal, post-operative evaluation is done after 3 days, at suture removal approx..2 weeks, 1 month and finally around 3-4 months before an implant procedure was planned.

After a healing phase of approx. 3 months, the augmented alveolar segment was again measured clinically & radiographically.

Depending on the measurements obtained the implant size was determined. After which an implant procedure was planned.

Prior to the implant placement procedure, a-silicon impressions were taken and model cast obtained.

Surgical technique for Implant placement: -

Patient was draped and site preparation done by scrubbing betadine solution. Local anaesthesia was given and a full thickness flap was raised. The ridge visualized and dimensions measured with the help of a marked probe. The width of the socket was measured mesio-distally and bucco-lingually to the base of the crestal bone, the height of the buccal and lingual bone plate was clinically measured to the nearest 0.5 mm at the mid-buccal and mid-lingual aspect. These are the same measurements done at the time of socket preservation both in Group A and Group B. With the help of the marking drill (Lancet drill) the point of placement of the Implant is marked, with an initial depth of approx. 3mm. after which sequential drilling done with a proper axis and the implant is gently screwed in place.

Based on the density of bone (ZARB classification) D2, D3 bone were expanded with lateral condensing osteotomes as shown by Lee H Silverstein et al, 1999 [52] to maintain the bone structure which otherwise could be lost due to drilling. The Endossous implant (Adin Universal system) implants were screwed in place and in all cases except one the primary stability was above 40 N. The implants were slightly submerged to 1mm into the bone to compensate for the crestal bone loss. In cases where there was thread exposure, a secondary bone grafting with Bio-Oss and Bioresorbable membrane was done.

This was followed by approximation of the mucoperiosteal flap and closure was done with 3-0 or 4-0 ethilon suture. Final irrigation of the site was done with saline and the regular oral surgical case post op instructions were given to all patients.

Suture removal was done at about 2 weeks and the patient was reviewed for any signs of pain or discomfort. The patients were advised to wait for approx. 3-4 months for the integration of the implants depending on the site in which they were placed.

Second stage surgery:

The implants were left for 3-4 months approx. after which IOPA radiograph was taken to check for any evidence of radiolucency surrounding the implant. Radiolucency extending till the apex of the implant was considered as failure. The implants were also clinically checked for stability. After confirming osseointegration the implants proceeded for prosthetic rehab.

In all patients, the cover screw was exposed under local anaesthesia infiltration and healing abutment placed with minimal flap elevation. The healing abutment was left in place till a sufficient amount of soft tissue cuff was formed around it. Patients were advised strict oral hygiene measures with peri-mucositis in mind.

After 10-14 days the healing abutment was removed and open tray impression was made using a-silicon impression material. The final prosthesis

was fabricated and the crown was placed in proper functional and esthetic position.

EVALUATION CRITERIA: -

1. Following extraction, the desired socket preservation method is employed and the socket measured clinically by caliper/marked probe (in mm) and radiographically (in mm).
2. Clinically the Bucco-lingual width & vertical height with the mucogingival junction as reference
3. Radiographically the vertical height is measured with the Cemento-enamel junction off the adjacent tooth as reference
4. Implant success is calculated by the ICOI criteria [53].

The clinical buccolingual width and mesiodistal width was measured with a caliper or a marked periodontal probe, the radiological vertical height (long cone paralleling angle technique which is a measurement from the adjacent tooth's root tip/CEJ to the visible outer cortical lining) are measured immediately following extraction, prior to implant placement after approx. 3 months and at the time of loading at approx. 6-8 months. The point of highest prominence of mesial and distal was connected, form the median to the socket tip (apical foramen) is done to calculate the radiograph height. The other variables like age, gender, smoking status, gingival and periodontal status etc., were calculated and seen that both the groups were evenly distributed. The various variables were tabulated and checked for statistical significance.

RAGAS DENTAL COLLEGE

CASE HISTORY

Name: Age/Gender:

Address:

Nativity:

Contact no:

Occupation:

Religion:

Chief complaint:

History of presenting illness: pain/sensitivity

Past Medical history:

Past Dental history:

Family history:

Personal history:

Pernicious habits: nail biting/tongue thrusting/thumb sucking/mouth breathing/bruxism

Deleterious habits:

Oral hygiene practice:

Brushing Type:

Duration:

Frequency:

GENERAL EXAMINATION:

Vitals:

Pulse: Respiratory rate:

Blood pressure: Temperature:

EXTRAORAL EXAMINATION:

TMJ: CLICKING/DEVIATION

Max. Mouth opening:

Lymph node examination:

INTRA ORAL EXAMINATION:

Number of teeth present:

Decayed:

Missing:

Filled:

Trauma from occlusion:

Type of occlusion:

Concerned tooth to be replaced with an implant:

Reason for extraction of the non-restorable tooth: 2^0 caries/periodontal problem/RCT failure/periapical pathology/fracture/

History of RCT in the associated tooth:

History of trauma associated with the tooth:

Periodontal status of the tooth: healthy/unhealthy

Clinical Alveolar width:

Clinical Alveolar height:

Gingiva: Flat & thick/ Scalloped & thin

Height of the opposite occluding tooth:

If present in the esthetic zone:

Smile line:

Dental midline/Facial midline:

Lip length:

Lip line:

Overjet/overbite:

RADIOGRAPHIC ASSESSMENT:

Interproximal bone height:

Density of bone: Class 1/Class 2/Class 3/Class 4

Gingival contour:

Radiographic Length of the non-restorable tooth:

Radiographic mesio-distal width of the non-restorable tooth at crown:

Radiographic mesio-distal width of the non-restorable tooth at root:

Interdental bone thickness:

Root orientation:

Distance from the canal/sinus:

AFTER EXTRACTION:

Buccal bone thickness:

Lingual bone thickness:

Socket dimensions:

Extracted tooth dimensions:

PATIENT ASSESSMENT:

Awareness about the treatment: yes/no

Awareness about implants: yes/no

Character: hysterical/cooperative

Overall satisfaction:

S.no	After socket preservation	Before implant placement	At the time of loading of the implant
Clinical bone height			
Clinical mesiodistal width			
clinical buccolingual width			
Radiographic height mesial			
Radiographic height distal			
Interdental bone			
Height of the occluding tooth			

Addition findings/comments:

Figures

INSTRUMENTATION

Fig. 1 Surgical Instruments

Fig.2 Adin Dental Implant kit

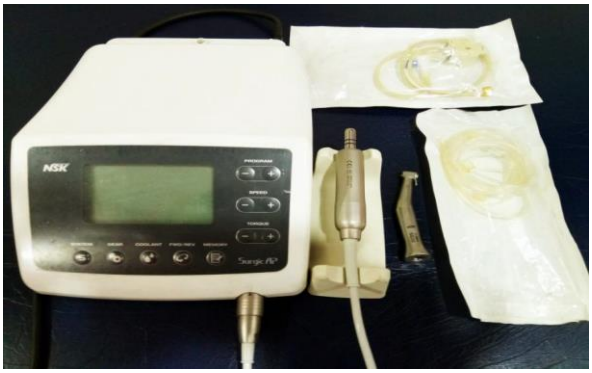


Fig. 3 Physio-dispenser

Fig. 4 Armamentarium for Socket measurements

Fig. 5 Bio-Oss Bone Graft

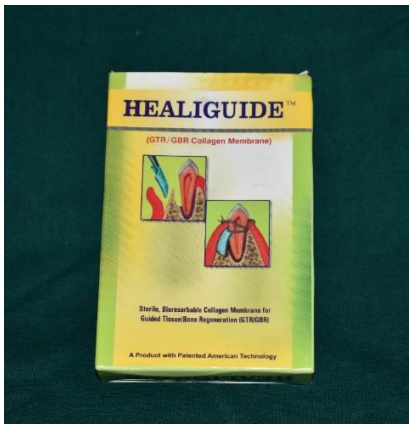


Fig. 6 Healiguide GTR collagen Membrane

CASE 1 – GROUP A (BIO-OSS)

Fig. 7 Non-restorable tooth in relation to 21

Fig. 8 Pre-Op IOPA

Fig. 9 Bio-Oss bone graft

Fig. 10 Socket filled with Bio-Oss bone graft

Fig. 11 Resorbable membrane placed over bone graft

Fig. 12 Closure of the socket done with 3-0 silk suture

Fig. 13 Preserved socket ready to receive the Dental Implant

Fig. 14 IOPA of the healed socket

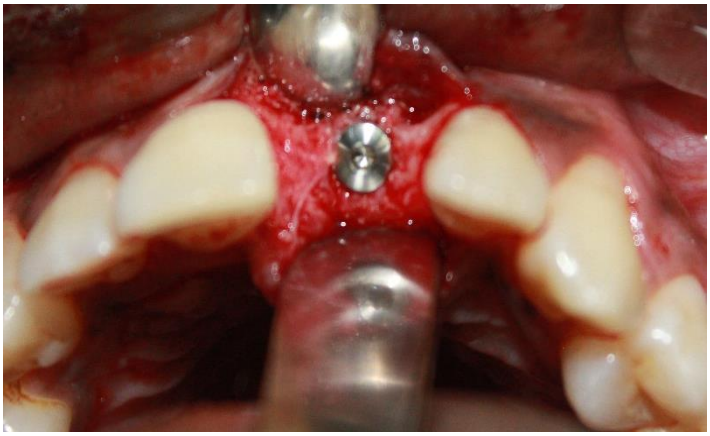


Fig. 15 Implant placed in the Preserved socket

Fig. 16 IOPA of the placed Implant

Fig. 17 Implant crown fixed in place

CASE 2 – GROUP B (BIO-OSS WITH PRF)

Fig. 18 Preoperative Intraoral photograph – tooth concerned 21

Fig. 19 Preoperative IOPA of 21 region

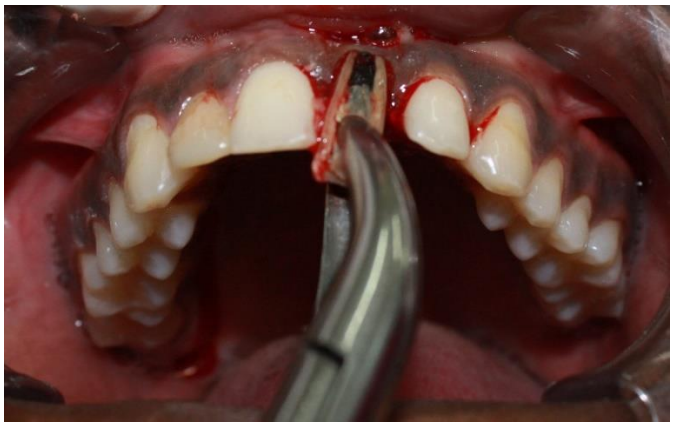


Fig. 20 Atraumatic extraction Preserving the Buccal bone

Fig. 21 PRF prepared prior to socket preservation

Fig. 22 Extraction of PRF

Fig. 23 Mixing PRF with BIO-OSS

Fig. 24 Packing the Site with the Mixture

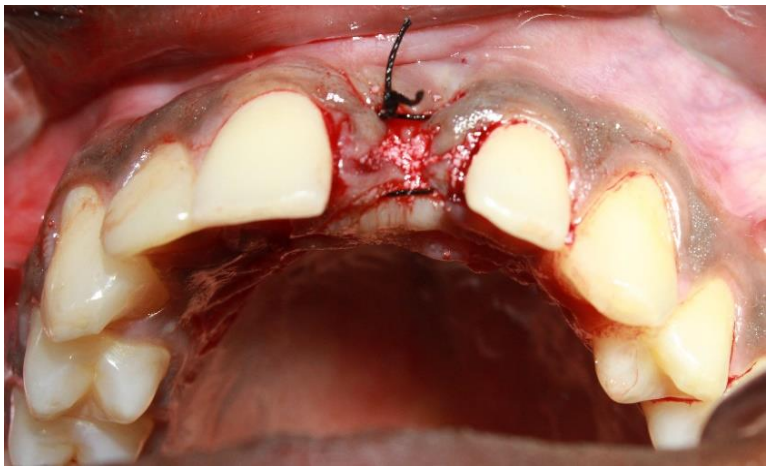


Fig. 25 Final suturing

Fig. 26 IOPA of Preserved socket after 3 months

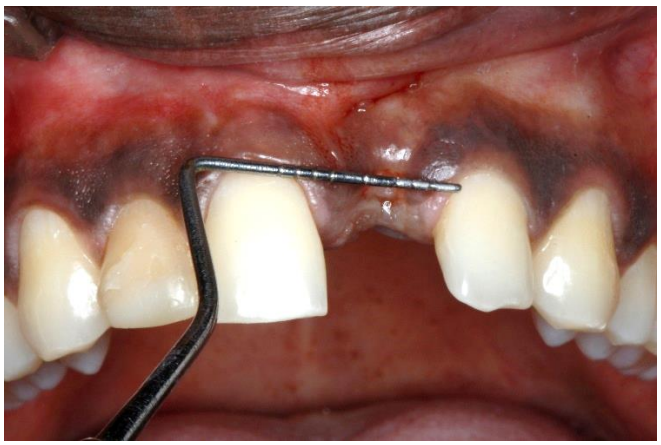


Fig. 27 Preserved socket Mesio-distal measurement

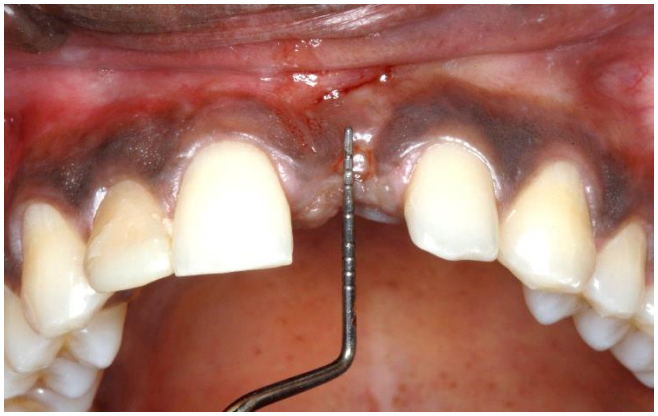


Fig. 28 Preserved socket Bucco-lingual measurement

Fig. 29 Implant placed in the Preserved Socket

Fig. 30 Suturing with 4-0 ethilon

Fig. 31 Implant placed in the Preserved site

Fig. 32 Final Prosthesis in place

Results

RESULTS

Our study was done to evaluate the dimensional changes in the socket preservation site with either Bio-Oss bone graft alone (Group A) or Bio-Oss mixed with PRF (Group B) and to finally check the success of implants placed in the site loaded after successful evidence of osseo-intergation. Based on the inclusion criteria the patients requiring socket preservation with a future implant placement in mind were selected. They were randomly assigned into the two groups. This study evaluated 16 sites in 14 patients who reported to the outpatient department, Department of Oral and Maxillofacial Surgery, Ragas Dental College, Uthandi, Chennai.

Data obtained was entered in excel sheet and analyzed using SPSS version 20. Normality of data was tested using Shapiro Wilks test and Unpaired 't' test was used for data that followed normal distribution and Mann Whitney 'u' test was used for non-parametric data. Mean and standard deviation was calculated for all the quantitative variables. Frequency distribution was calculated for qualitative data and chi square test was used to test for any difference between the two groups.

Both the groups were evenly distributed with respect to Gender, Site, Smoking status, Gingival and Periodontal Status, root orientation and ease of extraction. Of those 14 patients 9 were male (60%) and 5 were female (40%),

ranging from age of 18-55. Seven patients (50%) were non-smokers while the rest were occasional smokers (< 5 per week). Out of the 7 patients in Group A, 5 sites were in the anterior region and 2 were posterior teeth while in Group B, 6 sites were in anterior region and 1 in the posterior region. In group A, 4 patient's site was in maxilla and 3 in mandible while in group B, 6 patient's site was in maxilla and 1 in mandible. Together a total of 10 in the maxilla and 4 in the mandible. The gingiva was scalloped and thin in 3 patients in Group A and 4 patients in Group B. The gingiva was flat and thick in 4 patients of Group A and 3 patients of Group B. Only 2 of the entire study subjects, both in Group B showed little signs of increased probing depth, rest of them had healthy periodontal status. The root orientation was straight in 12 patients which was evenly distributed between the groups, 1 divergent root was in group A and 1 intruded root in Group B. Though very subjective and difficult to define, 2 extractions in each group were difficult extractions. Care was taken to preserve the buccal bone as much as possible and any inadvertent fracture was minimized.

Between the two groups i.e., Bio-Oss separately (Group A) and Bio-Oss mixed with PRF (Group B) as the socket preservation agent, the quantitative variables including the site's clinical alveolar width of mid-buccal to mid-palatal measurement, mesio-distal width, the clinical height of both the mesial and distal side with the mucogingival junction as the reference was

calculated. The Intra Oral Periapical Radiographic readings of mesial and distal height were also recorded.

All these reading was recorded in three stages/phases

Stage 1 - following extraction, at the time of socket preservation

Stage 2 - at the time of the implant procedure in the preserved site

Stage 3 - at the time of implant loading after evidence of successful osseointegration.

By interpretation of the statistics there was no statistically significant finding in clinical alveolar width, clinical alveolar height and radiographic height between the two groups both in group A and group B. The mesio-distal width was statistically significant suggestive there was a drift of the adjacent teeth in Group B.

All the 16 implants placed in 16 sites of both group A and group B were successful and a survival rate of 100% was noted at 6 months after the loading of implants. One patient in group A did not report and got the prosthetic loading and restoration procedure done in another institution in their hometown but gave a report of a successful implant procedure.

Though utmost care was given to conserve as much bone as possible and grafting and GTR procedures were followed still it did not completely eliminate the use of additional bone grafts at the time of implant placement,

not for stability but to overcome thread exposure. The use of osteotome (Umtiti Equinox) was also done for lateral condensation of bone for successful placement of implants with good primary stability.

Tables and Graphs

TABLE 1 : GENDER DISTRIBUTION

		GENDER		Total	p- VALUE
		FEMALE	MALE		
GROUP	BIO OSS	3	4	7	1.000
	BIO OSS +PRF	2	5	7	
Total		5	9	14	

TABLE 2 : SMOKING STATUS DISTRIBUTION

		SMOKING STATUS		Total	p - VALUE
		NON SMOKER	OCCASIONAL SMOKER		
GROUP	BIO OSS	4	3	7	1.000
	BIO OSS +PRF	3	4	7	
Total		7	7	14	

TABLE 3 : ARCH DISTRIBUTION

		ARCH		Total	p - VALUE
		UPPER	LOWER		
GROUP	BIO OSS	4	3	7	0.559
	BIO OSS +PRF	6	1	7	
Total		10	4	14	

TABLE 4 : SITE DISTRIBUTION

		ANTERIOR/POSTERIOR		Total	p – VALUE
		ANTERIOR	POSTERIOR		
GROUP	BIO OSS	5	2	7	1.000
	BIO OSS +PRF	6	1	7	
Total		11	3	14	

TABLE 5 : GINGIVAL STATUS DISTRIBUTION

		GINGIVA		Total	p - VALUE
		SCALLOPED AND THIN	FLAT AND THICK		
GROUP	BIO OSS	3	4	7	1.000
	BIO OSS +PRF	4	3	7	
Total		7	7	14	

TABLE 6 : PERIODONTAL STATUS DISTRIBUTION

		PERIO STATUS		Total	p - VALUE
		HEALTHY	UNHEALTHY		
GROUP	BIO OSS	7	0	7	.462
	BIO OSS +PRF	5	2	7	
Total		12	2	14	

TABLE 7 : STAGE 1 – VARIABLES AT THE TIME OF EXTRACTION

	GROUP A		GROUP B		
VARIABLES	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**p-value**
CLINICAL ALVEOLAR WIDTH	7.24	1.459	6.43	.980	.248
MESIO DISTAL WIDTH	8.28	2.306	7.95	.981	.735
HEIGHT DISTAL	7.63	1.070	7.82	1.479	.785
HEIGHT MESIAL	8.10	1.206	7.60	1.126	.432
IOPA DISTAL	12.35	1.676	11.50	1.224	.296
IOPA MESIAL	12.35	1.546	11.17	1.260	.142

TABLE 8 : STAGE 2 – VARIABLES BEFORE IMPLANT PLACEMENT

	GROUP A		GROUP B		
VARIABLES	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**p-value**
CLINICAL ALVEOLAR WIDTH	7.57	1.397	6.81	1.020	.269
MESIO DISTAL WIDTH	8.42	2.387	7.92	.975	.617
HEIGHT DISTAL	7.78	1.112	7.85	1.655	.926
HEIGHT MESIAL	8.31	1.300	7.52	1.113	.248
IOPA DISTAL	12.35	1.676	11.42	1.096	.244
IOPA MESIAL	12.28	1.272	10.92	1.272	.089

TABLE 9: STAGE 3 – VARIABLES BEFORE IMPLANT LOADING

	GROUP A		GROUP B		
VARIABLES	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**p-value**
CLINICAL ALVEOLAR WIDTH	9.21	1.496	8.64	1.886	.542
MESIO DISTAL WIDTH	8.28	2.306	7.95	.981	.738
HEIGHT DISTAL	7.82	1.196	8.25	.946	.472
HEIGHT MESIAL	8.46	1.103	7.60	1.019	.157
IOPA DISTAL	12.64	1.749	11.85	1.214	.348
IOPA MESIAL	12.78	1.523	11.35	1.281	.082

TABLE 10: TEST OF SIGNIFICANCE FOR BOTH GROUPS

Ranks					
	Group	**N**	**Mean Rank**	**Sum of Ranks**	**P - VALUE**
SOCKET MESIO DISTAL	BIO OSS	7	9.86	69.00	.033
	BIO OSS + PRF	7	5.14	36.00	
	Total	14			
SOCKET WIDTH	BIO OSS	7	6.86	48.00	.558
	BIO OSS + PRF	7	8.14	57.00	
	Total	14			

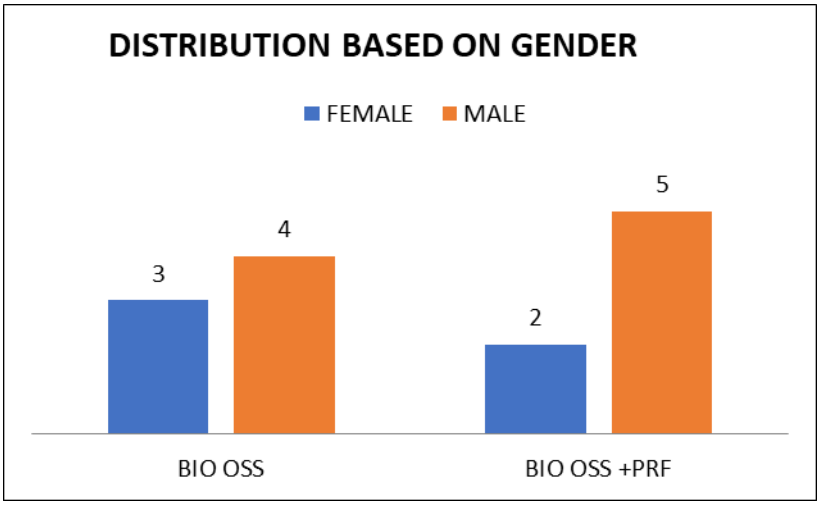
TABLE 11: DISTRIBUTION BASED ON ADDITIONAL BONE GRAFTING PROCEDURE

		ADDITIONAL BONE GRAFT		**Total**	**P - VALUE**
		YES	**NO**		
GROUP	BIO OSS	2	5	7	1.000
	BIO OSS +PRF	3	4	7	
Total		5	9	14	

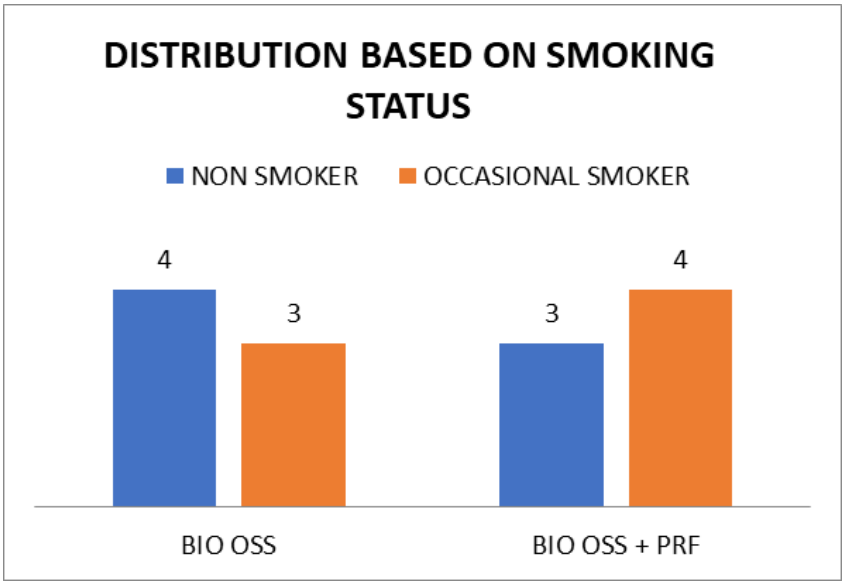
TABLE 12 : DISTRIBUTION BASED ON WHETHER OSTEOTOME TECHNIQUE WAS USED FOR IMPLANT PLACEMENT.

		OSTEOTOME USED		Total	P - VALUE
		YES	NO		
GROUP	BIO OSS	3	4	7	1.000
	BIO OSS +PRF	4	3	7	
Total		7	7	14	

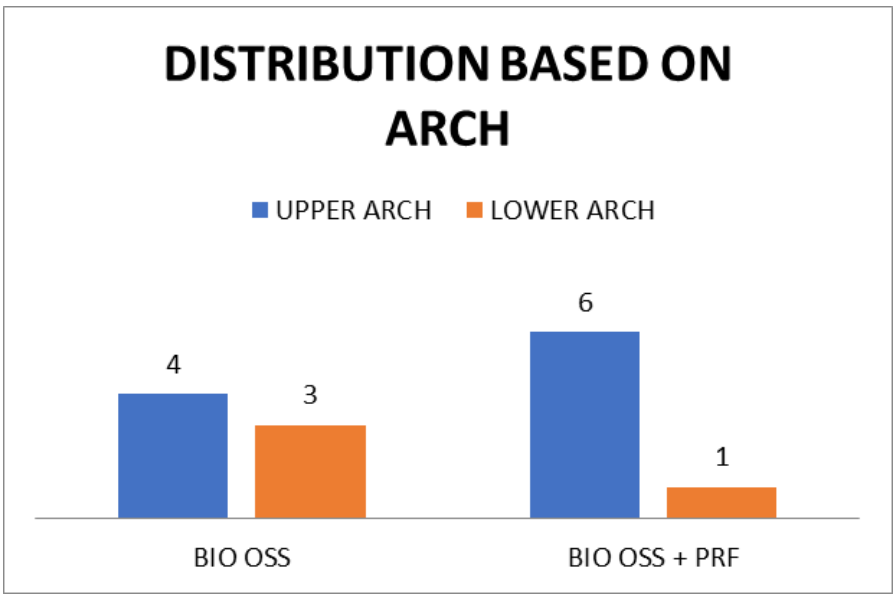
GRAPH 1 : DISTRIBUTION BASED ON GENDER



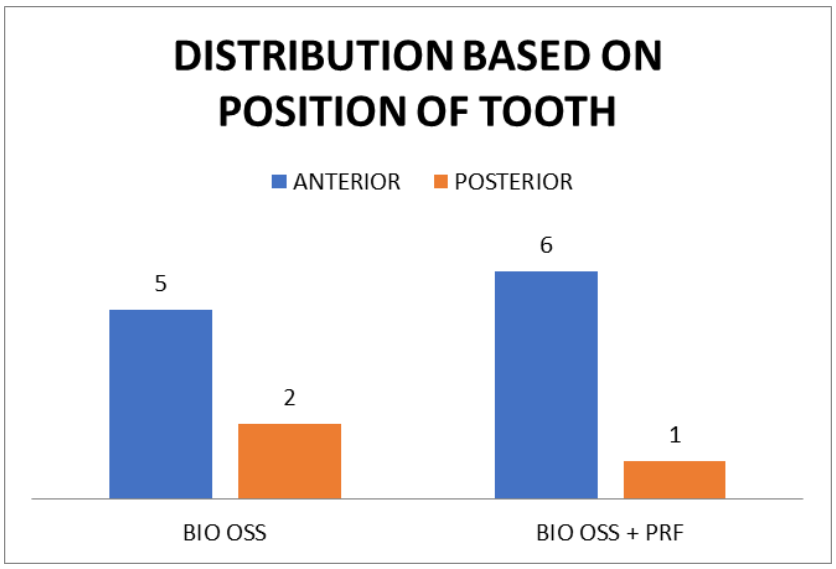
GRAPH 2 : DISTRIBUTION BASED ON SMOKING STATUS



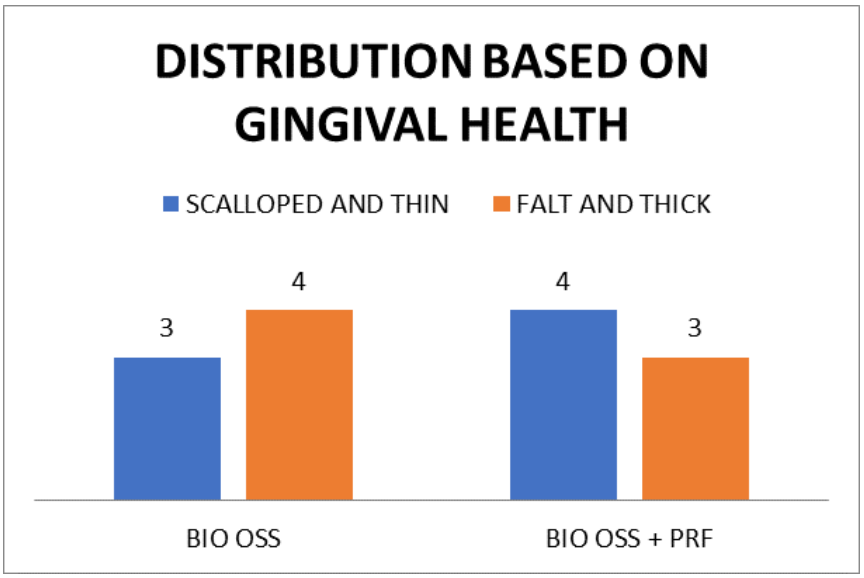
GRAPH 3 : DISTRIBUTION BASED ON ARCH



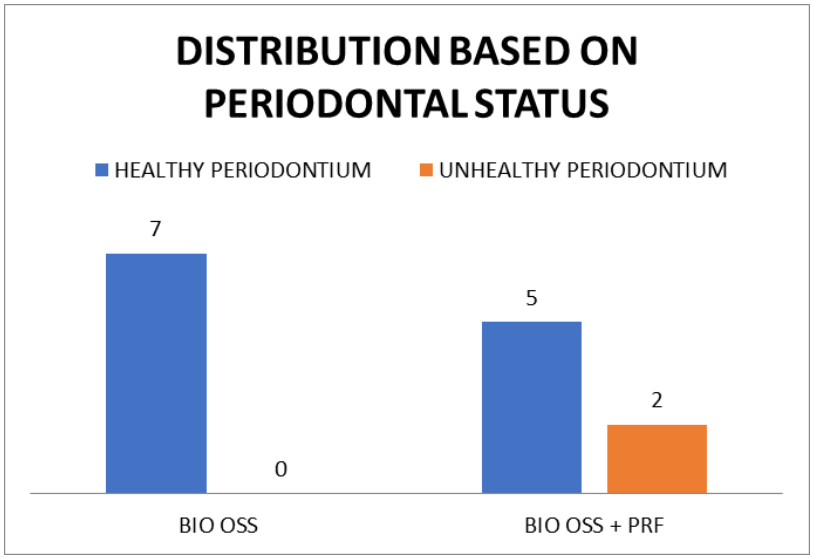
GRAPH 4 : DISTRIBUTION BASED ON POSITION OF TOOTH



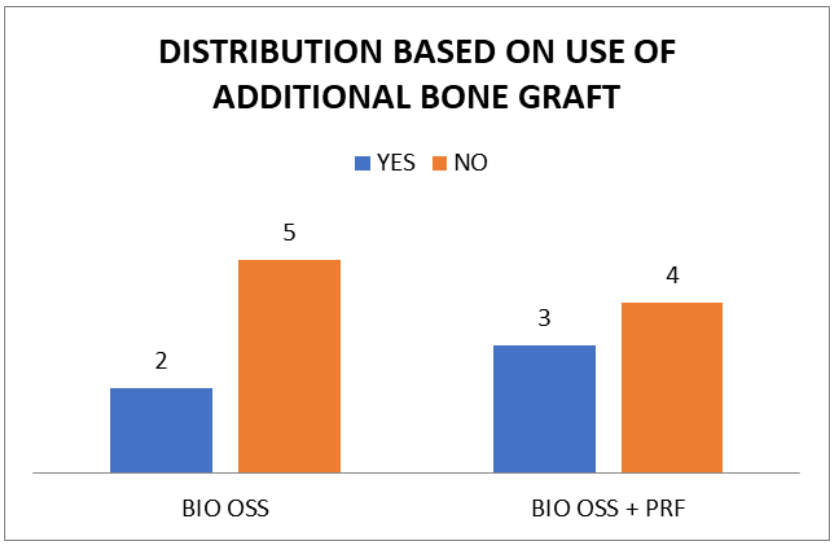
GRAPH 5 : DISTRIBUTION BASED ON GINGIVL HEALTH



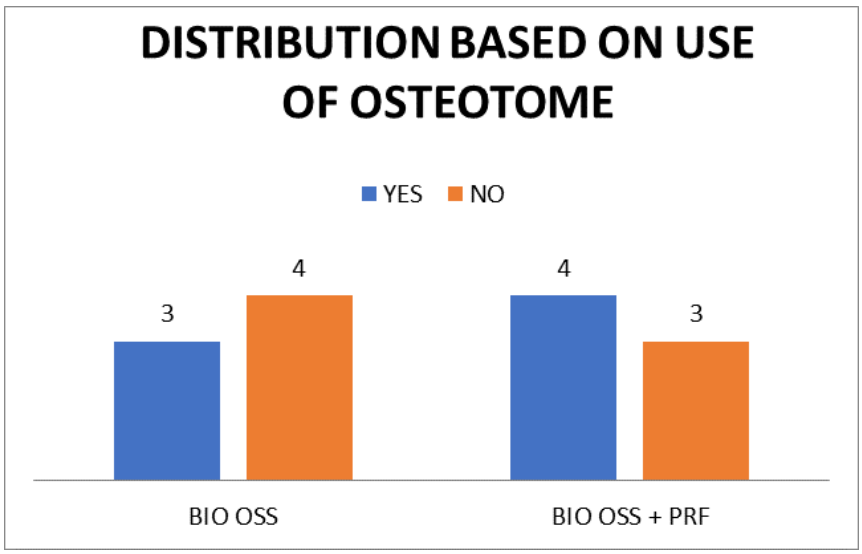
GRAPH 6 : DISTRIBUTION BASED ON PERIODONTAL HEALTH



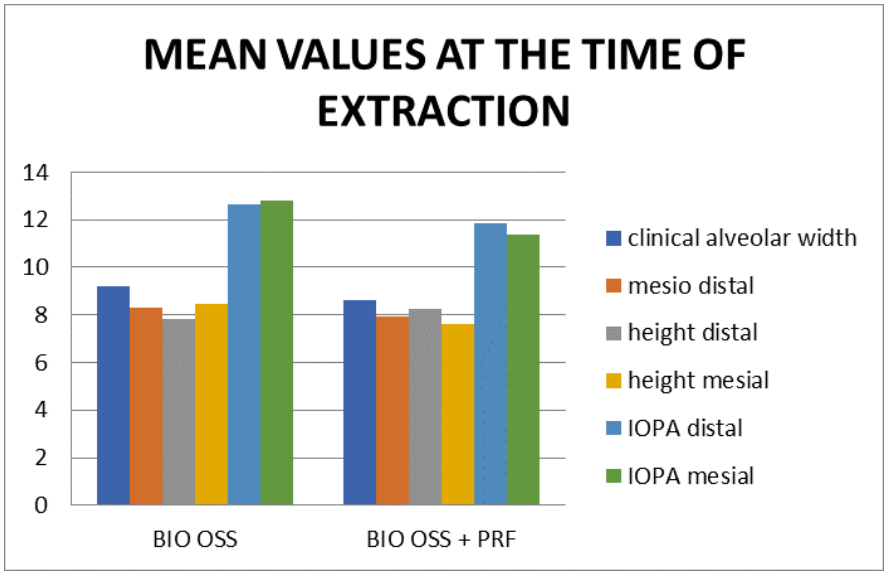
GRAPH 7 : DISTRIBUTION BASED ON USE OF ADDITIONAL BONE GRAFT



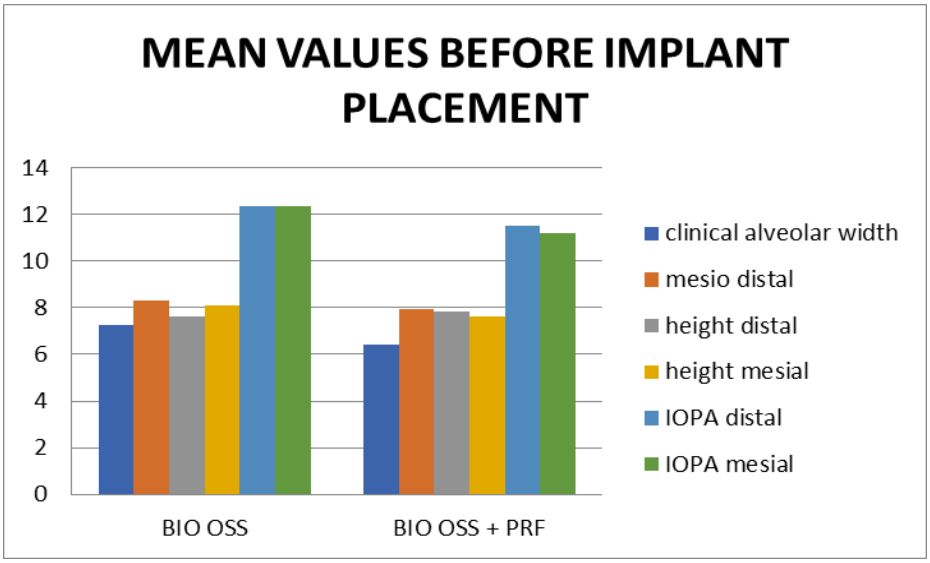
GRAFT 8 : DISTRIBUTION BASED ON USE OF OSTEOTOME



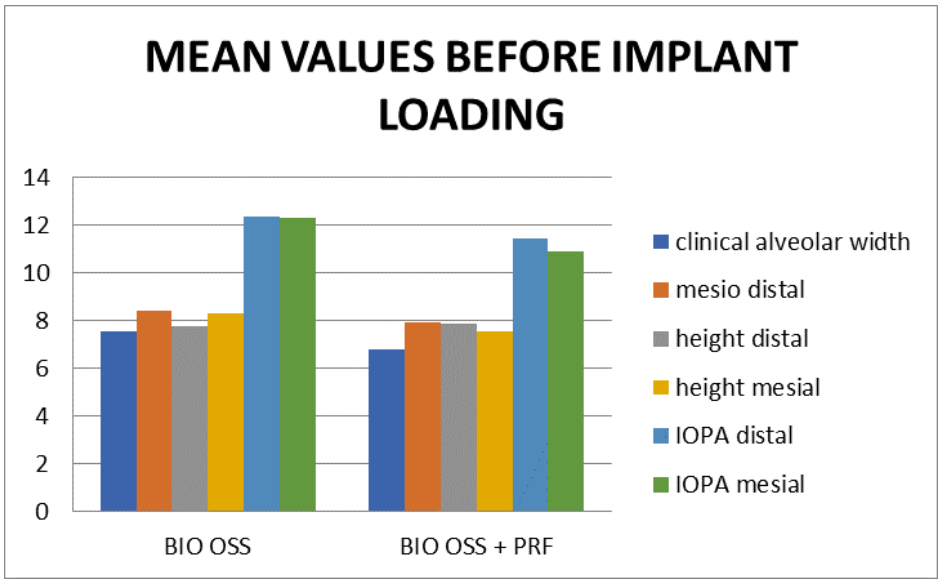
GRAPH 9 : STAGE 1 VALUES



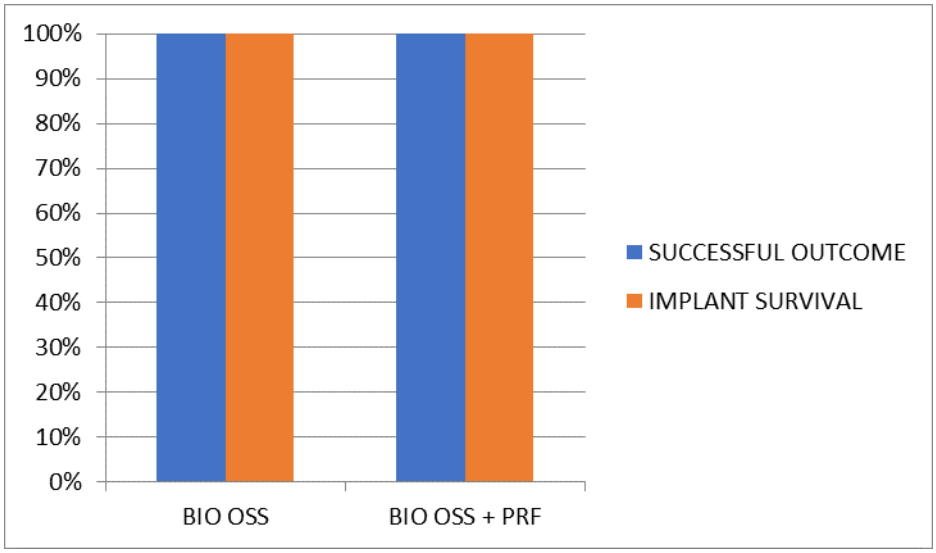
GRAPH 10 : STAGE 2 VALUES



GRAFT 11 : STAGE 3 VALUES



GRAPH 12 : IMPLANT SUCCESS AND SURVIVAL



Discussion

DISCUSSION

Wound healing in the alveolar socket is characterized by resorption in all three dimensions. Lam RV in 1960 [54] noted that pattern of resorption in an extraction socket happens within the first year after tooth extraction, with nearly 2/3rds of the resorption happening in the first 3 months. In another study by Johnson in 1969 [55] even before the turn of the century, in addition to the various research that was done to determine the socket dimensional changes at sequence after extraction and found that 40-60% of the bone loss occurs after the first two years. Pietrovshi &Massler 1967 [56] showed that the majority of post extraction bone loss happens on the buccal aspect of the ridge. The normal healing process takes place over a period of 40 days [57]. More often than not, bone resorption happens in the horizontal plane than the vertical plane. The presence of bone dehiscence or fenestrations during extractions further increase the post extraction bone resorption, resulting in even more buccal concavity.

Various research has been carried out to overcome this long and well-established problem of resorption of the alveolar socket after tooth extraction but less conclusive results have instigated further research in this grey field. Therefore, preserving what is already available with respect to socket architecture is of prime importance as it is for any restorative medical

procedure for that matter. The resorption that is inevitable, leaves behind esthetic and restorative challenges and calls for a more complicated implant placement procedure with variable success. Alveolar socket preservation is a procedure to reduce the bone loss after tooth extraction and to preserve the remaining bone as much as possible with a future tooth restoration in mind, even more so when a future implant placement is warranted. The aim of implant dentistry is to restore missing or extracted teeth by placing implants in anatomically, esthetically and long-term functional restorative position.

A recent concept given Araujo MG in 2005 [58] is the placement of immediate implants itself as the socket preservation agent with or without the use of bone grafts depending on the concept of jumping distance. But this is not always feasible, when there is a risk of not achieving primary stability due to the socket architecture, or a call for elaborate surgical technique; it is worthwhile and a standard procedure to do socket preservation to preserve the ridge as much as possible. Though socket preservation drastically minimizes or reduces the need for further augmentation at the time of implant placement, it may not completely eliminate the need for further augmentation.

Various materials have been used as Bone preserving agents. The various types of bone grafts available commercially, now more than ever have different properties that indicate its use one over the other. But still the gold standard against which other grafting materials are compared is autogenous bone graft i.e. the patient's own bone. It has all the three properties of Osseo-

conduction, Osseo-induction and Osseogenesis. But that being said, it has the downside of morbidity of a second surgical site. After years of research the recent commercially available products are developed to closely mimic the autogenous bone properties.

Bio-Oss (Geistlich Pharma), a xenograft is by far the most researched bone graft material with proven success in literature [59,60]. It has a microstructure that is very similar to natural homo-sapien bone which acts as a scaffold for bone formation into the graft. In study by Elizabeth Tomlin [12] it was shown that the graft particles remain in the preserved socket even after 3 months of grafting but had attained sufficient strength to undertake an implant procedure.

After the introduction of the fibrin glue which revolutionized the field of wound healing, after (platelet rich plasma) PRP which has lost its significance recently owing to its complex blood handling properties, now Platelet rich fibrin PRF has come a long way in establishing its stake. PRF due to its versatility has been extensively used in various fields in oral and maxillofacial surgery owing to its tissue healing properties. Preparation is by Choukroun 2001introduced with the European directive n. 2004/23/CE of March 31, 2004.

Thus, in the present study either Bio-Oss separately or Bio-Oss mixed with PRF was used in two groups as the socket preservation agent. Between the groups there was no gender predilection along with other variables were

evenly distributed. Since smoking has adverse effects on the outcome of the grafting procedure, heavy smokers were excluded from the study. Only occasional smokers (> 5 per week) and non-smokers were included. It was noted that all the occasional smokers were male. Similarly, very severe periodontal conditions which result in severe compromised bone levels were excluded form the study as it would affect evaluation.

Atraumatic tooth extraction protocols were strictly followed, with preservation of the buccal bone. Any inadvertent breaking of chipping of the bone was in no way tried to be placed in its original place instead it as removed and the site flushed with normal saline. Any buccal bone fracture greater than 2 mm were excluded from the study as it would affect the evaluation.

It is much debatable whether to open a full thickness flap with sulcular incisions to visualize the underlying bone and then do the atraumatic extraction or on the contrary to keep the flap elevation minimal and do the extraction and directly preserve the site. The rationale behind this is the concept that when the marginal bone is stripped of its periosteum some amount of marginal bone loss in bound to happen. With conserving as much bone as possibly can, judicious working with the soft tissue flap is necessary to ensure the best possible outcome [61,62].

In our study, the bone graft was placed and wetted with saline in Group A and obtained as a workable mass. It was carefully placed inside the socket

and not packed hard. This is to encourage a blood fill within the graft materials which would clot and hold the mass in place and also start the healing and bone formation processes.

There is a hypothesis that buccal overbuilding will result in decreased resorption and that even after the resorption process there would be sufficient bone left but this lost its significance as this hypothesis is now proven to be completely unwarranted. Therefore, this concept of buccal overbuilding was not employed in our study instead there was just a gentle packing of the graft particles [30,32].

In Group B things were similar to Group A with few pre-treatment procedures including blood withdrawal and PRF preparation in centrifuge. It is based on the hypothesis that PRF along with bone grafts enhances osteogenic differentiation and bone repair [62]. A small twist was given to the original principle by (Choukroun in 2001) a slightly different rotation speed of 3500 rpm for 7 minutes, instead of the original 10 minutes and the PRF left in place for a few more minutes for the clot to form entirely [49,50]. The A-PRF was mixed with the bone graft while the L-PRF (leucocyte PRF) was made as a membrane and kept over the admixture. Few instances in literature have scorned the use of a membrane when PRF is used but in our study a membrane was also used to keep the groups' variables similar.

The clinical alveolar width which is the measure of mid-buccal and mid-palatal width was similar between both the groups soon after extraction.

A gross reduction was seen between the preserved site soon after extraction (stage 1) and after a min of 3 months when the patient came for implant placement procedure (stage 2) and a further more in most cases when the implants placed were to be loaded (stage 3). But this pattern of reduction in the width was similar in both the groups and was not statistically significant. Similar to our study Antonio in 2013 [63] and Ahmad in 2012 [38] have shown a approx. 20 % reduction in the socket width bucco-palatally and are not clinically and radiographically significant, but the Histomorphometric analysis showed statistical significance between the use of bone grafts alone or mixing with either PRF/PRP.

The mesiodistal width between the two groups were statistically significant. A loss of the mesiodistal width was noted in Group B. and this could not be attributed to any one particular reason other than a slight delay in the placement of interim prosthesis.

The clinical and radiographic alveolar height was measured. There was a reduction in the readings from the stage 1 to stage 2 and a further more in stage 3 that is at the time of loading but similar to the width measurements the concerned sites height was not statistically significant between the two group A & B. The overall reduction in height measurements were less than that of width measurements suggestive of greater resorption occurring in the bucco-palatal direction. And this is in line with the study by Pietrovshi &Massler in 1967 [56].

The surgical placement of implants was done by sequential drilling and use of bone expansion osteotome. The use of osteotomes have shown to be beneficial as understood by and also proven to be effective in a study done in our institution. The preserved site and bone levels achieved by socket preservation method aided in simple implant placement methods. Primary stability of greater than 40N was achieved in all but one case but at the end of 6 months there was adequate integration and stability for implant loading and a final crown fabricated.

Additional use of bone grafts at the time of implant placement was needed in a few patients in both the groups. A GTR membrane was used covering the bone graft. Unlike other instances, the additional bone grafting was done just to cover a few thread exposures and there was no relation to the stability of the implant.

All the implants placed, loaded and reviewed after 6 months in the sites were successful (100%) which shows the positive predictability of the socket preservation procedure, in accordance with the literature. The use of Bio-Oss bone graft is an efficient way of preserving the alveolar socket. It is known that PRF alone cannot effectively prevent the collapse of the buccal bone therefore mixing PRF with the Bio-Oss bone graft was envisaged as a better compound material in preserving the alveolar bone architecture.

The limitations of the study include the lack of use of CT measurements. The Histopathologic core bone samples of the preserved site

were not obtained and analyzed as we felt it would be inappropriate to give core bone sample with the grafted and normal bone in the field of view without compromising on the desired implant placement protocols. That being said Kutkat in 2012 [38] has shown statistical difference in a similar study. Soft tissue healing assessment was done but not recorded with photographic evidence and also implant stability was calculated but not numerically jotted with Radio-Frequency Analyzer (RFA) in ISQ units. A control group with no grafting would have further helped in assessing the degree of changes that happen with the use of socket preservation agents. A 6-8 month follow up is there for most patients yet a long term follow-up is to be obtained which would further add weightage to this study.

Summary and Conclusion

SUMMARY AND CONCLUSION

Alveolar socket wound healing is bound to cause loss of the original bony architecture with corresponding soft tissue alterations. This loss is impregnable and difficult to manage particularly when an implant procedure is to be done at a later stage. Preservation of the alveolar socket with bone grafts is a standard and facile procedure to preserve the socket architecture to facilitate simple implant placement.

Bio-Oss bone graft has the proper ingredients for a successful bone preserving agent. When mixed with PRF, the biologic and handling properties are further envisaged.

Though the quantitative variables in our evaluation criteria obtained by mixing PFR with the Bio-Oss bone graft was not statistically significant in a broader perspective yet the use of it for tissue healing has been widely researched. Further Histo-morphologic and enzyme related studies have to be undertaken to stake the claim of PRF being remarkable when used with bone grafts.

Treatment planning and patient evaluation are of paramount importance. It would be a wise decision to employ a procedure like socket preservation at the time of extraction, which is very predictable than to wait for the normal healing to happen and compromise on either the surgical technique or ideal prosthetic position when a future implant placement is in mind. The process of socket preservation does in no means completely

eliminate a grafting procedure simultaneously along with implant placement but can drastically make the implant surgical procedure a simple one.

In our study, though statistical significance was not noted between the two groups contemplating the need for PRF but it can be said from our experience that the soft tissue healing in the group with PRF was better.

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Annexures

ANNEXURE I

RAGAS DENTAL COLLEGE & HOSPITAL
(Unit of Ragas Educational Society)
Recognized by the Dental Council of India, New Delhi
Affiliated to The Tamilnadu Dr. M.G.R. Medical University, Chennai
2/102, East Coast Road, Uthandi, Chennai - 600 119. INDIA.
Tele : (044) 24530002, 24530003-06. Principal (Dir) 24530001 Fax : (044) 24530009

TO WHOM SO EVER IT MAY CONCERN

Date: 07-01-2019,
Chennai.

From,
The Institutional Review Board,
Ragas Dental College and Hospital,
Uthandi, Chennai-600119.

The Dissertation topic titled "**EVALUATION OF THE OUTCOME OF ALVEOLAR SOCKET PRESERVATION BY PLACING EITHER BIO-OSS; OR BIO-OSS WITH PRF, FOLLOWED BY DELAYED IMPLANT PLACEMENT – A PROSPECTIVE CLINICAL STUDY**" Submitted by **DR. STEPHEN RAJKUMAR. J** has been approved by the Institutional Review Board of Ragas Dental College & Hospital.

Dr. N S Azhagarasan, M.D.S
Member Secretary,
Institutional Ethical Board,
Ragas Dental College and Hospital,
Uthandi, Chennai-600119.

ANNEXURE II

IMPLANT CONSENT FORM

Date:

Patient consent:

I have been fully informed of the nature of the dental implant surgery, the procedure to be utilized, the risks and benefit of the surgery and the necessity for follow up care and self-care. I have had an opportunity to ask any questions I may have in connection with the treatment and to discuss my concerns with the doctor. After thorough deliberation, I hereby consent to perform the Dental implant surgery.

I also consent to use of an alternative Implant system or method if clinical conditions is found to be unfavorable for the use of the implant systems that has been described to me. If clinical conditions prevent the placement of implants, I agree to my doctor's judgement on the surgical management of that situation. I also give my permission to receive any supplemental bone grafts and membrane or any other type of grafts to build up my ridge of my jaw. The placement, closure and security of my implant's full procedure was explained to me in my own language.

I CERTIFY THAT I HAVE READ AND FULLY UNDERSTAND THIS DOCUMENT

Patient's signature with Name:

Witness's signature with Name:

ANNEXURE III

URKUND

Urkund Analysis Result

Analysed Document: plagarism check.docx (D47222540)
Submitted: 1/25/2019 7:16:00 AM
Submitted By: nasri_stephen@yahoo.in
Significance: 4 %

Sources included in the report:

LATERAL BONE CONDENSATION AND EXPANSION FOR PLACEMENT OF ENDOSSEOUS DENTAL IMPLANT IN DEFICIANT MAXILLA.docx (D34832186)
EVALUATION OF OUTCOME OF SINGLE MANDIBULAR MOLAR TOOTH REPLACEMENT BY TWO NARROW DIAMETER DENTAL IMPLANTS.docx (D35006713)
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5577438/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4040934/
https://www.ijahs.net/uploads/2/6/7/7/26772457/04_ijahs_2_10__01_cr.pdf

Instances where selected sources appear:

9